Surprising Possibilities Imagined and Realized through Information Technology: Encouraging High School Girls' Interests in Information Technology

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Abstract:

SPIRIT is a three year project designed to increase high school students' interests in and their desire to pursue IT careers. This paper examines the results of the project during its second year of implementation. All student participants, and in particular female students, experienced a positive change in perception of gender stereotypes in IT after attending the SPIRIT program (p=0.028 and p=0.022, respectively). Participating teachers' and counselors' attitudes with respect to professionals in IT improved after attending SPIRIT (p=0.046 and p=0.022, respectively). Emergent theme analysis of the short answer responses to the attitude survey provides additional insights concerning the program's impact.

Introduction

Over the last several decades, there has been a shortage of female students who pursue careers in information technology (IT) in the United States. National Science Foundation (NSF) data indicates that only 27% of all mathematics and computer science bachelor degrees granted in 2006 were awarded to women (2008). Furthermore, the number of females pursuing degrees in mathematics and computer science has been declining in the U.S. since 1991 (NSF, 2008). Factors contributing to this shortage include the beliefs held by many pre-college women that they would be isolated in IT due to their gender, that they do not have a strong enough mathematical or computing background to pursue an IT career, or that their socioeconomic challenges would prevent them from fully participating in this field (Kissinger et al., 2009; Nicholls et al., 2007; Stump et al., 2009; Trenor et al., 2008). Interestingly, Shashaani found that female and male students differ significantly with regards to confidence in using computers, even when female students score equal to or better than male students in introductory computer science courses (1997).

Early classroom exposure to computers and programming may impact the rate at which female students select to pursue careers in IT. High school courses in computing have been found to increase students' knowledge of and confidence toward computer science (Baker et al., 2007; Shashaani, 1997). It has also been found that the more experience students have with computers and programming in high school, the more likely they are to enroll and succeed in computer science courses in college (Goode, 2007, Lam et al., 2005). One software program that has been used to encourage positive attitudes toward computing is the Alice software, developed and released by Carnegie Mellon University (http://www.alice.org/). Alice is a three-dimensional programming environment that uses a drag-and-drop editor to create animations for storytelling and gaming applications. Students can learn the algorithmic reasoning of programming through the Alice software without experiencing the frustration of syntactical errors.

Another important component of attracting students to computing fields is exposing them and their teachers to the exciting career opportunities that are available in IT. Showcasing opportunities within IT or other STEM-related fields may peak students' interest and participation in computing (Cantrell & Ewing-Taylor, 2009; Heersink & Moskal, 2010; Lam et al., 2008; Mahmoud, 2005; Matson et al., 2004; Murphy et al., 2007). Given this, preparing our nation's students and their teachers with knowledge and experience in computing is vital to increasing students' participation in computing, regardless of their gender or ethnicity (Goode, 2007; Margolis et al., 2003).

The Surprising Possibilities Imagined and Realized through Information Technology (SPIRIT) is a three-year project sponsored by the National Science Foundation [NSF, DRL-0737679] under the direction of Alka Harriger at Purdue University. This paper examines the results of the project during its second year of implementation. Information concerning the first year's outcomes has been previously published (Harriger, 2008; Munson et al., 2009). SPIRIT is designed to increase students' interests in and their desire to pursue IT careers. A primary target population for this investigation is female high school students; their male counterparts are included here as a comparison group. In order to impact students beyond those directly involved in the current program, high school teachers and guidance counselors were also included. Through a summer program, teachers, counselors, and students were provided with instruction that included professional presentations from the IT community and an overview of the Alice software. The overriding goals of this project are to increase students' confidence and abilities in using technology, to improve student attitudes with respect to the field of IT, and to inform all participants of the various career possibilities available in IT (Harriger et al., 2007).

Research Questions

The research questions that guided this investigation are:

1. Did the participating teachers, counselors and students display a significant change in their attitudes toward IT from the beginning to the end of the summer program?

2. Did participation in this program have a different impact on male and female students' attitudes with respect to IT?

Methods

This section begins with a description of the 2009 summer program, which includes both the program's design and a description of the participating population. This is followed by a discussion of the Attitude Survey, which was completed in pre and post format by the participating teachers, counselors and students.

Summer Program Design

The summer program was two weeks in duration and was taught by college faculty and educational consultants from the Computing and IT department at Purdue University. High school teachers participated in the full two week program. The participating teachers taught a variety of subjects in both arts and sciences. Counselors and high school students joined the teachers during the second week. During the first week, the teachers were taught both basic and advanced features of the Alice software and were shown examples of Alice lesson plans which were designed to illustrate mathematics and science content. The teachers were asked to convert three of their own traditional mathematics or science lesson plans into Alice-based lesson plans. During the second week, the participating teachers pilot tested their Alice-based lesson plans with the other participating teachers and with small groups of participating students. Based on feedback that they received, the teachers refined their lesson plans for use during the academic year (Harriger, 2008).

During the second week of the summer program, the participating teachers were joined by counselors and students. A part of the teachers' roles in this second week was assisting the college faculty and educational consultants as they taught the Alice software to the counselors and students. An important aspect of the SPIRIT program was the use of the Alice software for storytelling. According to Hanor (1998), female students enjoy using software to create stories and to communicate their ideas. The goal of using the Alice software in this study was not to convince students to become programmers but rather to demonstrate that the Alice software may be used as a tool, much like Microsoft Word, Publisher, and PowerPoint.

In addition to the Alice software, the SPIRIT program exposed participants to the many unexpected benefits that IT provides to society. Researchers have found that understanding the interpersonal applications of a given career is important for increasing female interest in that career (Morgan, Isaac & Sansone, 2001). Presentations were made by IT professionals and participants completed hands-on activities. Presenters, drawn from various fields, described how IT is used in their jobs, increasing both the efficiency and quality of their work. For example, a police officer and a software developer jointly described mobile applications used to investigate crime scenes. As part of this presentation, the participants were also able to try some of the software. Cyber forensics applications, such as the tracking of cell phones and other electronic devices, were discussed as methods for collecting evidence that is used in the prosecution of criminals. Two projects were assigned to the students during the second week: creating an Alice world and building a PowerPoint slideshow which either illustrated the student's version of a popular story or which described the student's career goal. Counselors were given the assignment of creating an Alice world that illustrated career opportunities in IT. Alice worlds from counselors and students and Alice lesson plans from teachers were posted online and made available to other SPIRIT participants for reference.

On the last day, parents and other family members attended a luncheon during which the events of the previous week were highlighted. The climax of this event was the presentation of the students' Alice worlds.

Population

The participating population for this project was high school teachers, counselors and students, with an emphasis on female students. The 2009 summer program was attended by twenty-four high school teachers, fourteen high school counselors and seventy-six high school students. Of the seventy-six high school students, fifty-four were female and twenty-two were male.

Attitude Survey

The attitude survey used in the summer workshop was adapted from a computer sci-

ence attitude survey which was developed and validated through another NSF grant (Moskal et al., 2005-2009). The statements on this survey were adapted for the current project to reflect IT rather than computer science. The only difference between the original survey and the one used here is that the term "information technology" replaced "computer science" throughout the instrument. The research within technology often does not separate between computer science and IT. Given that the computer science attitude survey was developed based on the general research within technology rather than a specific base in computer science, the wording change to IT can be supported.

The attitude survey uses a four-point Likert scale with the following categories: strongly agree, agree, strongly disagree, and disagree. No neutral category was provided in order to force respondents to select between positive or negative judgments. Each participant's responses to the statements on the attitude survey were mapped to a numerical value between zero and three, with higher values reflecting more positive attitudes. In other words, a positively worded statement was scored a three for strongly agree, a two for agree, a one for disagree, and a zero for strongly disagree. A negatively worded statement was scored a three for strongly disagree, a two for disagree, a one for agree, and a zero for strongly agree. Participants' total scores were calculated by summing the score for each answered statement.

The constructs measured through the teachers' and counselors' attitude survey were:

- Confidence: confidence in their own ability to learn computing skills;
- Interest: interests in computing;
- Gender: perceptions of computing as a male field;
- Usefulness: beliefs in the usefulness of learning computing; and
- Professional: beliefs about professionals in computing.

The need for a separate student version of this survey was the result of prior research which found that high school students do not have an adequate understanding of IT and are therefore unable to respond to the various constructs represented on the teacher and counselor survey (Heersink and Moskal, 2010). The student version of the attitude survey was shortened to twenty statements measuring two constructs: general beliefs about IT and gender stereotypes in IT. The statements that comprise both instruments are displayed in Tables 1–2.

Teachers and Counselors

1. I am comfortable with learning computing concepts.
2. I would **not** take additional information technology courses if I were given the opportunity.
3. I have little self-confidence when it comes to computing activities.
4. I do **not** have a good understanding of computing concepts.
5. I think information technology is boring.
6. My career requires the use of information technology concepts.
7. The challenge of solving problems using information technology does **not** appeal to me.
8. I doubt that a woman could excel in computing courses.
9. Developing computing skills has **not** played a role in helping me achieve my career goals.
10. I like to use information technology to solve problems.
11. Men are more capable than women at solving computing problems.
12. Knowledge of computing has allowed me to secure a good job.
13. Doing well in information technology does **not** require a student to spend most of his/her time at a computer.
14. I use computing skills in my daily life.
15. Computing is an appropriate subject for both men and women to study.
16. It is not appropriate for men to study computing.
17. My career does **not** require that I have computing skills.
18. Women are more capable than men at solving computing problems.
19. I have a lot of self-confidence when it comes to teaching computing courses.
20. Women are more likely to excel in careers that involve computing than men are.
21. A student who performs well in information technology will probably **not** have a life outside of computers.
22. I do **not** like using information technology to solve problems.
23. I am confident that I can solve problems by using computer applications.
24. Women produce higher quality work in computing than men.
25. Women and men can both excel in careers that involve computing.
26. I doubt that a man could excel in computing courses.
27. It is not appropriate for women to study computing.
28. The challenge of solving problems using information technology appeals to me.
29. To do well in information technology, a student must spend most of his/her time at a computer.
30. Men produce higher quality work in computing than women.
31. Developing computing skills will be important to my career goals.
32. Knowledge of computing skills has **not** helped me secure a good job.
33. Men are more likely to excel in careers that involve computing than women are.
34. A student who performs well in information technology is likely to have a life outside of computers.
35. Women produce the same quality work in computing as men.
36. Being good at information technology is a negative quality.
37. Students who are skilled at information technology are less popular than other students.
38. Men and women are equally capable of solving computing problems.
39. I doubt that I can solve problems by using computer applications.
40. I think information technology is interesting.
41. Being good at information technology is a positive quality.
42. Men and women can both excel in computing courses.
43. I would voluntarily take additional information technology courses if I were given the opportunity.
44. Students who are skilled at information technology are just as popular as other students.
45. I do **not** use computing skills in my daily life.
46. Learning to use computing skills has helped me achieve my career goals.
47. Students who are skilled at information technology are more popular than other students.

Table 1. Teachers and Counselors Attitude Survey

Students
1. I hope that my future career will require the use of information technology concepts.
2. I like to use information technology to solve problems.
3. Women are more capable than men at solving computing problems.
4. I have a lot of self-confidence when it comes to computing courses.
5. Women are more likely to excel in careers that involve computing than men are.
6. I do **not** like using information technology to solve problems.
7. I am confident that I can solve problems by using computer applications.
8. Women produce higher quality work in computing than men.
9. It is not appropriate for women to study computing.
10. The challenge of solving problems using information technology appeals to me.
11. I doubt that a man could excel in computing courses.
12. Men produce higher quality work in computing than women.
13. Developing computing skills will be important to my career goals.
14. Men are more likely to excel in careers that involve computing than women are.
15. Women produce the same quality work in computing as men.
16. I expect that learning to use computing skills will help me achieve my career goals.
17. Men and women can both excel in computing courses.
18. I would voluntarily take additional information technology courses if I were given the opportunity.
19. Men and women are equally capable of solving computing problems.
20. I think information technology is interesting.

Table 2. Student Attitude Survey

The attitude survey concludes with the following four open-response questions:

- Describe, in detail, what information technology means to you.
- Please describe the characteristics of a person with a career in information technology.
- In your opinion, what are examples of careers in information technology?
- Describe, in detail, how you would encourage women to pursue a career in information technology.

Results

In order to measure change from pre to post assessment, paired t-tests were performed on the responses of each participating group: teachers, counselors and students. Only participants who completed both a pre and a post attitude survey were included in this analysis. Normality was confirmed for all groups except male students using box plots and the Shapiro-Wilk test for normality.

At the start of the 2009 summer workshop, there were twenty-four teachers, fourteen counselors, and seventy-six students. Our analysis includes only the twenty-three teachers, fourteen counselors, and seventy-four students who completed both the pre and post attitude survey. All groups were also examined for response differences between genders. All statistical analyses were completed in R, and the results of this analysis are displayed in Table 3.

As indicated in Table 3, the only statistically significant results found for teachers and counselors were in the professional construct for overall teachers, overall counselors, and female counselors. A statistically significant increase in the gender construct was detected for female students and for the larger student group. A statistically significant increase occurred for female students on the entire survey. For male students, there was a decline in attitudes from pre to post analysis for the entire survey and for the gender construct. This result could not be statistically tested due to the lack of normality in the male student data set.

Responses to the four open-response questions were also analyzed and summarized using emergent themes. First, one evaluator examined all of the data and identified common themes for each given question. This evaluator developed a definition for the themes, and a second evaluator independently categorized a random sample of statements based on these themes. The second evaluator correctly matched the responses to the themes 85%, 87.5%, and 91.5% of the time for the teachers, counselors, and students, respectively. The resultant themes are listed in Tables 4–11 for each of the four questions and divided by responding groups, along with the number of occurrences of a response within a given group. Participant responses that did not address the question were placed in a miscellaneous category.

Groups	Subdivisions	Number of Subjects	Mean Difference	p-value
Teachers	**All**	23	1.09	.609
	Confidence	23	0.43	.254
	Interest	23	0.30	.629
	Gender	23	-0.65	.300
	Usefulness	23	-0.48	.452
	Professional	23	1.48	.046*
	Female	14	2.86	.325
	Confidence	14	0.79	.144
	Interest	14	0.29	.754
	Gender	14	-0.43	.538
	Usefulness	14	0.29	.723
	Professional	14	1.93	.072
	Male	9	-1.67	.605
	Confidence	9	-0.11	.834
	Interest	9	0.33	.700
	Gender	9	-1.00	.434
	Usefulness	9	-1.67	.115
	Professional	9	0.78	.432
Counselors	**All**	14	3.71	.154
	Confidence	14	-0.21	.711
	Interest	14	0.93	.293
	Gender	14	1.43	.260
	Usefulness	14	-0.07	.927
	Professional	14	1.64	.022*
	Female	12	4.17	.169
	Confidence	12	0.33	.517
	Interest	12	0.75	.449
	Gender	12	1.67	.255
	Usefulness	12	-0.25	.782
	Professional	12	1.67	.046*
	Male	2	1.00	***
	Confidence	2	-3.50	***
	Interest	2	2.00	***
	Gender	2	0.00	***
	Usefulness	2	1.00	***
	Professional	2	1.50	***
Students	**All**	74	1.09	.061
	General	74	0.19	.640
	Gender	74	0.91	.028*
	Female	52	1.65	.022*
	General	52	0.15	.762
	Gender	52	1.50	.002*
	Male	22	-0.23	***
	General	22	0.27	.681
	Gender	22	-0.50	***

* indicates significance at α=.05

*** indicates sample normality assumption was violated and therefore a paired t-test for significance could not be completed.

Table 3. Attitude Survey Outcomes

Emergent Theme	Pre				Post			
	Teachers		Counselors		Teachers		Counselors	
	#	%	#	%	#	%	#	%
Technology/Information Processing/Problem Solving/Communication	22	85	10	83	18	75	13	100
Simplification of Tasks/Efficiency	0	0	0	0	3	13	0	0
The path to success/Job Opportunities	2	8	1	8	2	8	0	0
Miscellaneous	2	8	1	8	1	4	0	0

Table 4. Teachers, Counselors: Describe, in detail, what IT means to you.

Emergent Theme	Pre				Post			
	Female		Male		Female		Male	
	#	%	#	%	#	%	#	%
Technology/Information Processing/Problem Solving/Communication	36	72	18	86	41	77	16	73
Simplification of Tasks/Efficiency	0	0	2	9	1	2	1	5
The path to success/Job Opportunities	6	12	0	0	6	11	4	18
Miscellaneous	8	16	1	5	5	9	1	5

Table 5. Students: Describe, in detail, what IT means to you.

Emergent Theme	Pre				Post			
	Teachers		Counselors		Teachers		Counselors	
	#	%	#	%	#	%	#	%
Computer/Technology Skills or Enjoyment	6	25	3	23	1	4	0	0
Diverse vs. Stereotypes	2	8	1	8	2	9	0	0
Patient	3	13	0	0	1	4	0	0
Confident/Good Communicator/Team Member	0	0	1	8	2	9	1	8
Intelligent/Problem Solver/Hardworking	10	42	8	62	13	57	10	83
Creative	0	0	0	0	0	0	0	0
Miscellaneous	3	13	0	0	4	17	1	8

Table 6. Teachers, Counselors: Please describe the characteristics of a person with a career in IT.

For Tables 6 and 7, participant responses in the category "Diverse versus Stereotypes" stressed that a person in IT could have a diverse array of characteristics not limited to any stereotypes. For Tables 8 and 9, participant responses in the category "Any Career" indicate that IT is involved in most careers. For Tables 10 and 11, participant responses in the first category indicated the importance of stressing gender equality and ability in IT. If a participant stressed that outreach efforts should be focused on females who are already interested

Emergent Theme	Pre				Post			
	Female		Male		Female		Male	
	#	%	#	%	#	%	#	%
Computer/Technology Skills or Enjoyment	15	29	2	10	7	13	1	4
Diverse vs. Stereotypes	4	8	1	5	11	21	3	14
Patient	2	4	0	0	3	6	0	0
Confident/Good Communicator/Team Member	1	2	1	5	7	13	2	9
Intelligent/Problem Solver/Hardworking	22	42	8	40	17	33	13	59
Creative	2	4	1	5	3	6	0	0
Miscellaneous	6	11	7	35	4	8	3	14

Table 7. Students: Please describe the characteristics of a person with a career in IT.

Emergent Theme	Pre				Post			
	Teachers		Counselors		Teachers		Counselors	
	#	%	#	%	#	%	#	%
Computer Science or Engineer/ Graphic or Internet Design	14	61	7	58	15	65	6	46
Engineering/Robotics	0	0	1	8	1	4	0	0
Business	0	0	0	0	0	0	0	0
Education/Research	2	9	2	17	1	4	1	8
Healthcare	1	4	0	0	1	4	1	8
Forensic Science	0	0	0	0	1	4	1	8
Any Career	1	4	1	8	3	13	3	23
Miscellaneous	5	22	1	8	1	4	1	8

Table 8. Teachers, Counselors: In your opinion, what are examples of careers in IT?

in or have experience in IT, their response was placed into the fourth category. Participant responses in the fifth category referred to the SPIRIT program or similar academic programs.

Based on these tables, several differences can be identified from pre to post assessment. Tables 6 and 7 indicate that fewer teachers, counselors, and students on the post survey identified computing and technology skills and the degree to which an individual enjoys computers as a prerequisite for an IT career as compared to the pre survey. Parallel to this, there was an increase from pre to post assessment across groups, with the exception

Emergent Theme	Pre				Post			
	Female		Male		Female		Male	
	#	%	#	%	#	%	#	%
Computer Science or Engineer/ Graphic or Internet Design	26	52	15	75	25	47	11	50
Engineering/Robotics	6	12	0	0	4	7	2	9
Business	4	8	0	0	1	2	1	4
Education/Research	2	4	0	0	1	2	0	0
Healthcare	0	0	0	0	5	9	1	4
Forensic Science	0	0	0	0	4	8	2	9
Any Career	0	0	1	5	9	17	3	14
Miscellaneous	12	24	4	20	4	7	2	9

Table 9. Students: In your opinion, what are examples of careers in IT?

Emergent Theme	Pre				Post			
	Teachers		Counselors		Teachers		Counselors	
	#	%	#	%	#	%	#	%
Reinforce Gender equality/ability	1	4	0	0	1	4	0	0
Provide information about IT/careers in IT	9	39	5	45	10	43	9	69
Positive Female Role Models/Mentoring	1	4	0	0	4	17	0	0
Encourage Females with IT skills	0	0	4	36	0	0	2	15
School Programs/Courses/Activities/ Other Opportunities	9	39	2	18	6	26	1	8
Miscellaneous	3	13	0	0	2	9	1	8

Table 10. Teachers, Counselors: Describe, in detail, how you would encourage women to pursue a career in IT.

Emergent Theme	Pre				Post			
	Female		Male		Female		Male	
	#	%	#	%	#	%	#	%
Reinforce Gender equality/ability	13	25	5	25	8	15	3	14
Provide information about IT/careers in IT	16	31	6	30	23	44	8	36
Positive Female Role Models/Mentoring	1	2	0	0	1	2	1	4
Encourage Females with IT skills	0	0	1	5	0	0	0	0
School Programs/Courses/Activities/ Other Opportunities	6	12	0	0	7	13	3	14
Miscellaneous	15	29	8	40	13	25	7	32

Table 11. Students: Describe, in detail, how you would encourage women to pursue a career in IT.

of counselors, on the recognition that being a good communicator and team player was essential to IT. Interestingly, with the exception of female students, all groups experienced an increase from pre to post assessment on identifying the characteristics of a person in IT as intelligent, hardworking, and a problem solver. As indicated in Table 8 and Table 9, there was also an increase from pre to post assessment across all groups in the recognition that IT careers exist across many or all fields. Table 10 and Table 11 indicate an increase across groups in the belief that information about IT and IT careers should be provided to encourage female participation in IT. Fewer students expressed the importance of reinforcing gender equality and ability from pre to post assessment, as reported in Table 11.

A closer examination of female and male students' responses revealed differences between gender groups. Table 5 indicates that more female students associated IT with technology, communication, and the processing of information from pre to post assessment, while the opposite was true for male students. Table 5 also displays an increase for male students from pre to post in an understanding that IT degrees can result in an increase in job opportunities, but no such increase was witnessed for female students. Table 7 indicates that more male students considered a person in IT to be intelligent, hardworking and a problem solver from pre to post assessment, but the opposite was true for female students. Female students experienced a small increase in describing a person in IT as "creative" from pre to post assessment; the opposite was true for male students. Table 9 indicates that after attending SPIRIT, more male students identified careers in engineering, robotics and business as being IT-related, while the opposite was found for female students.

Discussion

Based on these results, it can be concluded that female high school students did display a statistically significant increase from pre to post assessment in their attitudes with respect to IT overall as well as within the gender construct. For female students, the response to the first research question appears to be "yes," there was a statistically significant change in female attitudes as a result of program participation. Examination of the mean difference scores displayed in Table 3 for teachers and counselors indicates that across gender subgroups there were improved attitudes with respect to the professional construct. It is possible that the small sample sizes for these subgroups prevented the identification of true change in other categories. The mean difference scores for male students displayed a decrease from pre to post assessment, indicating a decline in their attitudes; however, due to lack of normality, this could not be statistically examined. Based on the analysis of the constructs, this decrease for males occurred within the gender construct but, once again, could not be statistically confirmed due to concerns of normality. It appears that participation in this program did have a differing impact on the attitudes of females with respect to IT but not necessarily with males.

Emergent theme analysis of the short answer responses to the attitude survey provided additional insights concerning the program's impact. After attending the SPIRIT program, teachers, counselors, and students learned that IT exists across many or all careers, that being a good communicator and team player are essential to a career in IT, and that being skilled in computers or technology is not a prerequisite to a career in IT. After participating in SPIRIT, an increase in all groups, with the exception of female students, was witnessed in describing a person in IT as intelligent, hardworking, and a problem solver. The opposite was found for female students. All groups agreed that information about IT and careers in IT should be provided to encourage female participation in IT.

Further analyses of the short-answer responses revealed differences between gender groups. After attending SPIRIT, more female students associated IT with technology, communication and creativity, while the opposite was true for male students. Male students displayed an increase in associating a career in IT with an increase in job opportunities, but no increase was witnessed for female students in this category. After attending SPIRIT, more male students considered careers in engineering, robotics, and business as being IT-related, while the opposite was true for female students. These differences reveal that female students may find the communication and creativity aspects in IT appealing, while male students may find the problem solving aspects in fields that use IT, such as engineering and robotics, appealing.

It is encouraging that a two-week program, of which students only participated in one week, resulted in a statistically significant positive change in attitudes for female students. It is also interesting that the male students' attitudes were not similarly impacted. This may indicate that different forms of intervention are necessary to encourage the interests of male and females with respect to IT, as is supported by our qualitative results. Additional qualitative research is currently underway to determine whether the participating teachers were able to successfully transfer what they learned from the workshop to their classrooms, further impacting students', particularly female students', attitudes with respect to IT. Future research in this field is needed to examine the long-term stability of the witnessed change in female students' attitudes as well as methods for maintaining and further encouraging female interests and male interests in IT.

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